DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, D.C.

REPLY TO
ATTN OF: LEEEU

16 FEB 1983

SUBJECT: Engineering Technical Letter 83-1:
Design of Control Systems for Heating, Ventilating and Air Conditioning Systems (HVAC)

TO:

HQ AAC/DEE	HQ AFSC/DEE	HQ MAC/DEE	HQ AFCC/DEO
HQ ATC/DEE	HQ TAC/DEE	HQ AFLC/DEE	HQ SAC/DEE/DEER
HQ PACAF/DEE	HQ AFRES/DEE	HQ ESC/DEE	HQ USAFE/DEE/DEER
HQ USAFA/DEE	HQ AFCOMS/DEE	AFIT/DEE	AFMPC/MPCSXC
SPACECOM/DEE	NGB/DEE	AFRCE/CR	AFRCE/ER
AFRCE/WR	AFRCE/MX		

1. Purpose: This Engineering Technical Letter (ETL) provides a methodology for design of HVAC control systems. The methodology described is a general approach which must be used and tailored for each application. This policy is mandatory and is to be implemented immediately The policy will-be incorporated in the next revision of AFM 88-15, Chapter 6.

2. General: The policies and procedures developed will improve the operating efficiency of HVAC Systems at all Air Force bases. Many existing HVAC systems have design deficiencies which hamper efficient operation and routine recurring maintenance. The two most common problems are the lack of maintenance access to operating components that require periodic service, and the lack of access ports through which the technicians can measure flow, temperature, pressure, etc. to perform calibration and test procedures.

3. Applications:

a. Design of control systems for Heating, Ventilating and Air Conditioning Systems (HVAC) shall incorporate the following:

(1) design for maintainability

(2) design documentation

b. The design and construction efforts must facilitate both efficient operation and effective maintenance. With this fundamental objective, our construction policy is to provide control system designs which require consideration of control system maintainability. The design concepts will include, but not be limited to:

(1) Use of remote sensors so that controllers can be centrally located in the mechanical room.

(2) Logical grouping of controllers, adapters, relays and power supplies in an easily accessible controls cabinet mounted away from vibrating machinery.

(3) Inclusion of pneumatic test ports and electronic-system terminal strips cross-referenced to the control schematic to facilitate troubleshooting and calibration.

c. Since service has become a large part of the controls industry, the installation documents provided by the contractor usually contain proprietary symbology and terminology that are nonstandard. This documentation does not provide adequate information necessary for the construction inspection or the overall system logic required by Base Civil Engineer technicians to calibrate, maintain, or repair the system once installed. In a like manner, our policy is to assure that the design documentation provides the information required b base civil engineer maintenance technicians. The minimum information required is, but not limited to:

(1) A fully labeled control schematic which details all set points, throttling ranges, actions, spans, proportional bands, and any other adjustment.

(2) A fully labeled elementary diagram (ladder diagram).

(3) A sequence of control on the drawings cross-referenced to the control schematic and elementary diagram.

(4) A generic, functional description of each control component shown on the drawings.

d. Implementation of these steps will produce a design which can serve as both the construction documentation and the maintenance documentation. This policy is an important step toward solving our continuing energy-management problems by making our HVAC systems truly energy-efficient.

e. Typical HVAC Control System design drawings are attached for development of the contract design drawings. Although these drawings are for an electronic system, the concepts can be applied equally well with pneumatic systems.

4. A description of the key elements of the typical design drawings are as follows for CONTROL SYSTEM DESIGN - ELECTRIC AND PNEUMATIC:

a. Introduction

(1) The attached design consists of six basic elements:

(a) The Control Schematic

(b) The Elementary Diagram

(c) The Control Sequence

(d) The Description of Components

(e) The Control Panel Details

(f) Legends and Schedules

(2) Each of these elements contributes to the complete description of the desired system. These elements describe a very specific system that is energy efficient and has several maintenance features. Although the designs are very specific, they are still generic so that more than one manufacturer can bid the project.

b. The Control Schematic

The key characteristics of a control schematic are:

(1) It is drawn to a very large scale. This allows ample space to indicate all performance parameters such as set point, throttling range, action, etc. This large scale drawing is also easily read by the mechanic that will be using these drawings as part of his maintenance documentation.

(2) It is cross referenced to the elementary diagram and the control panel detail by the numbered terminal points enclosed in hexagons. These terminal points will also serve an important maintenance function. For example, to check the status of the air flow switch, AF, the mechanic will check continuity between the appropriate terminals. As the air flow switch is not nearly as accessible as the terminal strip, maintainability is enhanced.

(3) Each control component is identified by an alphanumeric designator such as C1 or SQ3. This provides for cross referencing to the description of components and the control sequence.

(4) On the pneumatic design, test ports for pressure measurements are required at all key points in the system.

c. The Elementary Diagram

The key characteristics of an elementary diagram are:

(1) It is drawn to a very large scale for easy reading and to provide space for indicating performance parameters.

(2) It is cross referenced to the control schematic and the control panel detail through the use of the numbered terminal points enclosed in hexagons.

d. The Control Sequence

The control sequence is a verbal statement of the sequence of operation. It should be as complete as possible, and it should refer to components by their alphanumeric designator. In describing the operation of a system, it is best if the system is first broken down into sub-systems such as fan section, mixed air section, beating coil, etc. This will make it easier to understand.

e. The Description of Components

In this section, the generic performance of each component should be described. The components should be referred to by their alphanumeric designator. The contractor should not be allowed to combine components or change performance parameters. This approach will enhance standardization and maintainability.

f. The Control Panel Detail

For maintainability, it is essential that there be some order to the installation of the control system. Components should not be installed on vibrating equipment or in inaccessible locations. The control panel concept consolidates key components in a central location along with the terminal strips for easy maintenance.

g. Legends and Schedules

The legends provide a definition of symbols and the schedules are designed to clarify the operation of the system.

5. Energy Management and Control Systems (EMCS)

a. The implementation of an EMCS requires interfacing standard HVAC equipment controls to the system. AFM 88-36, Chapter 7, identifies acceptable control system modifications and interfacing details. Providing control systems with magnetic contactor-type starters; including three position band-off-automatic switches, electrically resettable control point adjustment controllers and providing adequate mechanical room wall space for installation of EMCS field equipment, will ensure successful EMCS installation.

b. Where EMCS is being interfaced with existing HVAC controls, ensure systems controls function properly and that the interfacing is accomplished in the most maintainable manner. The use of a Data Termination Cabinet (DTC) to terminate remote sensors and controllers should be considered. As a minimum, all new construction will include the installation of EMCS related conduit and pull wires from remote points to the mechanical room.

6. Design Development Considerations:

a. These guide lines are to be utilized by:

(1) The Base and/or MAJCOM during master planning and MCP project booklet development.

(2) Base Project Engineers

(3) The A-E during the design stage of MCP projects.

FOR THE CHIEF OF STAFF

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1 Atch
HVAC Control System Drawing

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